



## SEQUENCE LISTING

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<120> MUTANT KANAMYCIN NUCLEOTIDYLTRANSFERASE AND A METHOD  
OF SCREENING THERMOPHILIC BACTERIA USING THE SAME

<130> 04853.0048-000000

<140> 09/697,186

<141> 2000-10-27

<150> JP 309616/1999

<151> 1999-10-29

<160> 20

<170> PatentIn Ver. 2.1

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<211> 253

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Mutant enzyme  
obtained by introduction of point mutation into  
wild type KNT gene of Staphylococcus aureus and  
its expression

<400> 1

Met Asn Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
1 5 10 15

His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
20 25 30

Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
35 40 45

Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Glu Ala Glu Phe  
50 55 60

Ser His Glu Trp Thr Thr Gly Glu Trp Lys Val Glu Val Asn Phe Tyr  
65 70 75 80

Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Gln Val Glu Ser Asp Trp  
85 90 95

Pro Leu Thr His Gly Gln Phe Phe Ser Ile Leu Pro Ile Tyr Asp Ser  
100 105 110

Gly Gly Tyr Leu Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
 115 120 125  
 Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
 130 135 140  
 Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
 145 150 155 160  
 Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
 165 170 175  
 Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Ser Val Leu  
 180 185 190  
 Thr Glu Ala Val Lys Gln Ser Asp Leu Pro Ser Gly Tyr Asp His Leu  
 195 200 205  
 Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
 210 215 220  
 Glu Ser Leu Glu Asn Phe Trp Asn Gly Ile Gln Glu Trp Thr Glu Arg  
 225 230 235 240  
 His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
 245 250

<210> 2

<211> 253

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Mutant enzyme  
 obtained by introduction of point mutation into  
 wild type KNT gene of Staphylococcus aureus and  
 its expression

<400> 2

Met Lys Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
 1 5 10 15  
 His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
 20 25 30  
 Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
 35 40 45  
 Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Gly Ala Glu Phe  
 50 55 60  
 Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
 65 70 75 80  
 Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Arg Val Glu Ser Asp Trp  
 85 90 95

Pro Leu Thr His Gly Arg Phe Phe Ser Ile Leu Pro Ile Tyr Asp Pro  
100 105 110

Gly Gly Tyr Phe Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
115 120 125

Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
130 135 140

Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
145 150 155 160

Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
165 170 175

Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Ser Val Leu  
180 185 190

Thr Glu Ala Val Lys Gln Pro Asp Leu Pro Ser Gly Tyr Asp His Leu  
195 200 205

Cys Gln Leu Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
210 215 220

Glu Ser Leu Glu Asn Phe Trp Asn Gly Ile Gln Glu Trp Thr Glu Arg  
225 230 235 240

His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
245 250

<210> 3

<211> 253

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Mutant enzyme  
obtained by introduction of point mutation into  
wild type KNT gene of Staphylococcus aureus and  
its expression

<400> 3

Met Lys Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
1 5 10 15

His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
20 25 30

Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
35 40 45

Ser Asp Ile Glu Met Met Cys Val Leu Ser Thr Glu Gly Val Glu Phe  
50 55 60

Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
65 70 75 80

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<210> 4
<211> 35
<212> DNA
<213> Artificial Sequence
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<220>  
<223> Description of Artificial Sequence: Primer for  
PCR amplification

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<400> 4
gactgtacgg gtacccgttg acggcggata tggta
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<210> 5
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<213> Artificial Sequence
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<220>  
<223> Description of Artificial Sequence: Primer for  
PCR amplification

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gactgtacgc tgcagcgtaa ccaacatgat taaca
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35

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<211> 35  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Description of Artificial Sequence: Primer for  
PCR amplification

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gactgtacgg aattcgagct cgagcaaatc taaaa 35

<210> 7  
<211> 35  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Description of Artificial Sequence: Primer for  
subcloning of WT

<400> 7  
gactgtacgc atatgaatgg accaataata atgac 35

<210> 8  
<211> 35  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Description of Artificial Sequence: Primer for  
subcloning of KT3-11 and HTK

<400> 8  
gactgtacgc atatgaaagg accaataata atgac 35

<210> 9  
<211> 35  
<212> DNA  
<213> Artificial Sequence

<220>  
<223> Description of Artificial Sequence: Primer for subcloning

<400> 9  
gactgtacgc tcgagcgtaa ccaacatgat taaca 35

<210> 10  
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<213> Staphylococcus aureus

<220>  
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<400> 10

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1 5 10 15	
cat gaa att aag gaa cga ata ttg gat aaa tat ggg gat gat gtt aag	96
His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys	
20 25 30	
gct att ggt gtt tat ggc tct ctt ggt cgt cag act gat ggg ccc tat	144
Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr	
35 40 45	
tcg gat att gag atg atg tgt gtc atg tca aca gag gaa gca gag ttc	192
Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Glu Ala Glu Phe	
50 55 60	
agc cat gaa tgg aca acc ggt gag tgg aag gtg gaa gtg aat ttt gat	240
Ser His Glu Trp Thr Thr Gly Glu Trp Lys Val Glu Val Asn Phe Asp	
65 70 75 80	
agc gaa gag att cta cta gat tat gca tct cag gtg gaa tca gat tgg	288
Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Gln Val Glu Ser Asp Trp	
85 90 95	
ccg ctt aca cat ggt caa ttt ttc tct att ttg ccg att tat gat tca	336
Pro Leu Thr His Gly Gln Phe Phe Ser Ile Leu Pro Ile Tyr Asp Ser	
100 105 110	
ggt gga tac tta gag aaa gtg tat caa act gct aaa tcg gta gaa gcc	384
Gly Gly Tyr Leu Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala	
115 120 125	
caa acg ttc cac gat gcg att tgt gcc ctt atc gta gaa gag ctg ttt	432
Gln Thr Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe	
130 135 140	
gaa tat gca ggc aaa tgg cgt aat att cgt gtg caa gga ccg aca aca	480
Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr	
145 150 155 160	
ttt cta cca tcc ttg act gta cag gta gca atg gca ggt gcc atg ttg	528
Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu	
165 170 175	
att ggt ctg cat cat cgc atc tgt tat acg acg agc gct tcg gtc tta	576
Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Ser Val Leu	
180 185 190	
act gaa gca gtt aag caa tca gat ctt cct tca ggt tat gac cat ctg	624
Thr Glu Ala Val Lys Gln Ser Asp Leu Pro Ser Gly Tyr Asp His Leu	
195 200 205	

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<210> 11
<211> 253
<212> PRT
<213> Staphylococcus aureus
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<400> 11																
Met	Asn	Gly	Pro	Ile	Ile	Met	Thr	Arg	Glu	Glu	Arg	Met	Lys	Ile	Val	
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His	Glu	Ile	Lys	Glu	Arg	Ile	Leu	Asp	Lys	Tyr	Gly	Asp	Asp	Val	Lys	
			20					25					30			
Ala	Ile	Gly	Val	Tyr	Gly	Ser	Leu	Gly	Arg	Gln	Thr	Asp	Gly	Pro	Tyr	
		35					40					45				
Ser	Asp	Ile	Glu	Met	Met	Cys	Val	Met	Ser	Thr	Glu	Glu	Ala	Glu	Phe	
	50					55					60					
Ser	His	Glu	Trp	Thr	Thr	Gly	Glu	Trp	Lys	Val	Glu	Val	Asn	Phe	Asp	
65					70					75					80	
Ser	Glu	Glu	Ile	Leu	Leu	Asp	Tyr	Ala	Ser	Gln	Val	Glu	Ser	Asp	Trp	
				85					90					95		
Pro	Leu	Thr	His	Gly	Gln	Phe	Phe	Ser	Ile	Leu	Pro	Ile	Tyr	Asp	Ser	
			100					105					110			
Gly	Gly	Tyr	Leu	Glu	Lys	Val	Tyr	Gln	Thr	Ala	Lys	Ser	Val	Glu	Ala	
		115					120					125				
Gln	Thr	Phe	His	Asp	Ala	Ile	Cys	Ala	Leu	Ile	Val	Glu	Glu	Leu	Phe	
	130					135					140					
Glu	Tyr	Ala	Gly	Lys	Trp	Arg	Asn	Ile	Arg	Val	Gln	Gly	Pro	Thr	Thr	
145					150					155					160	
Phe	Leu	Pro	Ser	Leu	Thr	Val	Gln	Val	Ala	Met	Ala	Gly	Ala	Met	Leu	
				165					170					175		
Ile	Gly	Leu	His	His	Arg	Ile	Cys	Tyr	Thr	Thr	Ser	Ala	Ser	Val	Leu	
			180					185					190			
Thr	Glu	Ala	Val	Lys	Gln	Ser	Asp	Leu	Pro	Ser	Gly	Tyr	Asp	His	Leu	
		195					200					205				

Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
 210 215 220

Glu Ser Leu Glu Asn Phe Trp Asn Gly Ile Gln Glu Trp Thr Glu Arg  
 225 230 235 240

His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
 245 250

<210> 12

<211> 253

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Mutant enzyme  
 obtained by introduction of point mutation into  
 wild type KNT gene of Staphylococcus aureus and  
 its expression

<400> 12

Met Asn Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
 1 5 10 15

Tyr Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
 20 25 30

Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
 35 40 45

Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Glu Ala Glu Phe  
 50 55 60

Ser His Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
 65 70 75 80

Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Arg Val Glu Ser Asp Trp  
 85 90 95

Pro Leu Thr His Gly Arg Phe Phe Ser Ile Leu Pro Ile Tyr Asp Pro  
 100 105 110

Gly Gly Tyr Phe Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
 115 120 125

Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
 130 135 140

Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
 145 150 155 160

Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
 165 170 175

Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Ser Val Leu  
 180 185 190



Thr Glu Ala Leu Lys Gln Ser Asp Leu Pro Ser Gly Tyr Asp His Leu  
 195 200 205

Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
 210 215 220

Glu Ser Leu Glu Asn Phe Trp Asn Gly Val Gln Glu Trp Ala Glu Arg  
 225 230 235 240

His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
 245 250

<210> 13

<211> 253

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Mutant enzyme  
 obtained by introduction of point mutation into  
 wild type KNT gene of Staphylococcus aureus and  
 its expression

<400> 13

Met Asn Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
 1 5 10 15

His Glu Ile Lys Glu Arg Ile Leu Asn Lys Tyr Gly Asp Asp Val Lys  
 20 25 30

Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
 35 40 45

Ser Asp Ile Glu Met Met Cys Val Leu Ser Thr Glu Gly Val Glu Phe  
 50 55 60

Ser His Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
 65 70 75 80

Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Gln Val Glu Pro Asp Trp  
 85 90 95

Pro Leu Thr His Gly Arg Phe Phe Ser Ile Leu Pro Ile Tyr Asp Ser  
 100 105 110

Gly Gly Tyr Leu Gly Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
 115 120 125

Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
 130 135 140

Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
 145 150 155 160

Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
 165 170 175

Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Leu Val Leu  
180 185 190

Thr Glu Ala Val Lys Gln Ser Asp Leu Pro Ser Gly Tyr Asp His Leu  
195 200 205

Cys Gln Leu Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
210 215 220

Glu Ser Leu Glu Asn Phe Trp Asn Gly Ile Gln Glu Trp Thr Glu Arg  
225 230 235 240

His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
245 250

<210> 14

<211> 253

<212> PRT

<213> Artificial Sequence

**<220>**

<223> Description of Artificial Sequence: Mutant enzyme obtained by introduction of point mutation into wild type KNT gene of Staphylococcus aureus and its expression

<400> 14

Met Asn Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
1 5 10 15

His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
20 25 30

Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
35 40 45

Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Gly Ala Glu Phe  
50 55 60

Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
65 70 75 80

Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Arg Val Glu Pro Asp Trp  
85 90 95

Pro Leu Thr His Gly Arg Phe Phe Ser Ile Leu Pro Ile Tyr Asp Ser  
100 105 110

Gly Gly Tyr Leu Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
115 120 125

Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
130 135 140

Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
145 150 155 160

Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
 165 170 175  
 Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Ser Val Leu  
 180 185 190  
 Thr Glu Ala Val Lys Gln Pro Asp Leu Pro Ser Gly Tyr Asp His Leu  
 195 200 205  
 Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
 210 215 220  
 Glu Ser Leu Glu Asn Phe Trp Asn Gly Val Gln Glu Trp Thr Glu Arg  
 225 230 235 240  
 His Gly Tyr Ile Val Asn Val Ser Lys Arg Ile Pro Phe  
 245 250

<210> 15

<211> 253

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Mutant enzyme  
 obtained by introduction of point mutation into  
 wild type KNT gene of Staphylococcus aureus and  
 its expression

<400> 15

Met Ser Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
 1 5 10 15  
 His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
 20 25 30  
 Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
 35 40 45  
 Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Gly Ala Glu Phe  
 50 55 60  
 Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
 65 70 75 80  
 Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Arg Val Glu Ser Asp Trp  
 85 90 95  
 Pro Leu Thr His Gly Arg Phe Phe Ser Ile Leu Pro Ile Tyr Asp Pro  
 100 105 110  
 Gly Gly Tyr Phe Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
 115 120 125  
 Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
 130 135 140

Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
 145 150 155 160  
 Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
 165 170 175  
 Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Thr Val Leu  
 180 185 190  
 Thr Glu Ala Val Lys Leu Ser Asp Leu Pro Ser Gly Tyr Asp His Leu  
 195 200 205  
 Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
 210 215 220  
 Glu Ser Leu Glu Asn Phe Trp Asn Gly Val Gln Glu Trp Thr Glu Arg  
 225 230 235 240  
 His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
 245 250

<210> 16  
 <211> 253  
 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Description of Artificial Sequence: Mutant enzyme  
 obtained by introduction of point mutation into  
 wild type KNT gene of Staphylococcus aureus and  
 its expression

<400> 16  
 Met Asn Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
 1 5 10 15  
 His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
 20 25 30  
 Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
 35 40 45  
 Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Glu Thr Glu Phe  
 50 55 60  
 Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
 65 70 75 80  
 Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Arg Val Glu Pro Asp Trp  
 85 90 95  
 Pro Leu Thr His Gly Lys Phe Phe Ser Ile Leu Pro Ile Tyr Asp Thr  
 100 105 110  
 Gly Gly Tyr Leu Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
 115 120 125

Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
 130 135 140

Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Leu Thr  
 145 150 155 160

Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
 165 170 175

Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Gly Ala Ser Val Leu  
 180 185 190

Thr Glu Ala Val Arg Gln Pro Asp Leu Pro Pro Gly Tyr Asp His Leu  
 195 200 205

Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
 210 215 220

Glu Ser Leu Glu Asn Phe Trp Asn Gly Ile Gln Glu Trp Ala Glu Arg  
 225 230 235 240

His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
 245 250

<210> 17

<211> 253

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Mutant enzyme  
 obtained by introduction of point mutation into  
 wild type KNT gene of Staphylococcus aureus and  
 its expression

<400> 17

Met Asn Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
 1 5 10 15

His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
 20 25 30

Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
 35 40 45

Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Gly Ala Glu Phe  
 50 55 60

Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
 65 70 75 80

Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Arg Val Glu Ser Asp Trp  
 85 90 95

Pro Leu Thr His Gly Arg Phe Phe Ser Ile Leu Pro Ile Tyr Asp Pro  
 100 105 110

Gly Gly Tyr Phe Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
 115 120 125  
 Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
 130 135 140  
 Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
 145 150 155 160  
 Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
 165 170 175  
 Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Ser Val Leu  
 180 185 190  
 Thr Glu Ala Val Lys Gln Pro Asp Leu Pro Ser Gly Tyr Val Gln Leu  
 195 200 205  
 Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
 210 215 220  
 Glu Ser Leu Glu Asn Phe Trp Asn Gly Ile Gln Glu Trp Thr Glu Arg  
 225 230 235 240  
 His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
 245 250

<210> 18  
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 <212> PRT  
 <213> Artificial Sequence

<220>  
 <223> Description of Artificial Sequence: Mutant enzyme  
 obtained by introduction of point mutation into  
 wild type KNT gene of Staphylococcus aureus and  
 its expression

<400> 18  
 Met Asn Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
 1 5 10 15  
 His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
 20 25 30  
 Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
 35 40 45  
 Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Gly Ala Glu Phe  
 50 55 60  
 Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
 65 70 75 80  
 Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Arg Val Glu Ser Asp Trp  
 85 90 95

Pro Leu Thr His Gly Arg Phe Phe Ser Ile Leu Pro Ile Tyr Asp Pro  
100 105 110

Gly Gly Tyr Phe Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
115 120 125

Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
130 135 140

Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
145 150 155 160

Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
165 170 175

Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Ser Val Leu  
180 185 190

Thr Glu Ala Val Lys Gln Pro Asp Leu Pro Ser Gly Tyr Val Gln Leu  
195 200 205

Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
210 215 220

Glu Ser Leu Glu Asn Phe Trp Asn Gly Ile Gln Glu Trp Thr Glu Arg  
225 230 235 240

His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
245 250

<210> 19

<211> 253

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<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Mutant enzyme  
obtained by introduction of point mutation into  
wild type KNT gene of Staphylococcus aureus and  
its expression

<400> 19

Met Asn Gly Pro Ile Ile Met Thr Arg Glu Glu Arg Met Lys Ile Val  
1 5 10 15

His Glu Ile Lys Glu Arg Ile Leu Asp Lys Tyr Gly Asp Asp Val Lys  
20 25 30

Ala Ile Gly Val Tyr Gly Ser Leu Gly Arg Gln Thr Asp Gly Pro Tyr  
35 40 45

Ser Asp Ile Glu Met Met Cys Val Met Ser Thr Glu Gly Ala Glu Phe  
50 55 60

Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
65 70 75 80

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<210> 20
<211> 253
<212> PRT
<213> Artificial Sequence
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<220>
<223> Description of Artificial Sequence: Mutant enzyme
      obtained by introduction of point mutation into
      wild type KNT gene of Staphylococcus aureus and
      its expression
```

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<400> 20
Met Asn Gly  Pro  Ile  Ile  Met  Thr  Arg  Glu  Glu  Arg  Met  Lys  Ile  Val
  1                      5                      10                      15

His  Glu  Ile  Lys  Glu  Arg  Ile  Leu  Asp  Lys  Tyr  Gly  Asp  Asp  Val  Lys
                20                      25                      30

Ala  Ile  Gly  Val  Tyr  Gly  Ser  Leu  Gly  Arg  Gln  Thr  Asp  Gly  Pro  Tyr
                35                      40                      45

Ser  Asp  Ile  Glu  Met  Met  Cys  Val  Leu  Ser  Thr  Glu  Glu  Ala  Glu  Phe
  50                      55                      60

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Ser Tyr Glu Trp Thr Thr Gly Glu Trp Lys Ala Glu Val Asn Phe Tyr  
 65 70 75 80  
 Ser Glu Glu Ile Leu Leu Asp Tyr Ala Ser Arg Val Glu Pro Asp Trp  
 85 90 95  
 Pro Leu Thr His Gly Lys Phe Phe Ser Ile Leu Pro Ile Tyr Asp Pro  
 100 105 110  
 Gly Gly Tyr Leu Glu Lys Val Tyr Gln Thr Ala Lys Ser Val Glu Ala  
 115 120 125  
 Gln Lys Phe His Asp Ala Ile Cys Ala Leu Ile Val Glu Glu Leu Phe  
 130 135 140  
 Glu Tyr Ala Gly Lys Trp Arg Asn Ile Arg Val Gln Gly Pro Thr Thr  
 145 150 155 160  
 Phe Leu Pro Ser Leu Thr Val Gln Val Ala Met Ala Gly Ala Met Leu  
 165 170 175  
 Ile Gly Leu His His Arg Ile Cys Tyr Thr Thr Ser Ala Ser Val Leu  
 180 185 190  
 Thr Glu Ala Val Lys Gln Pro Asp Leu Pro Ser Gly Tyr Val Gln Leu  
 195 200 205  
 Cys Gln Phe Val Met Ser Gly Gln Leu Ser Asp Ser Glu Lys Leu Leu  
 210 215 220  
 Glu Ser Leu Glu Asn Phe Trp Asn Gly Ile Gln Glu Trp Thr Glu Arg  
 225 230 235 240  
 His Gly Tyr Ile Val Asp Val Ser Lys Arg Ile Pro Phe  
 245 250